AMENDMENTS TO THE CLAIMS

Please amend the claims as set forth hereinbelow.

1-11. (withdrawn).

12. (currently amended) ~~A volume hologram~~ An optical apparatus comprising:
a volume hologram including a plurality of diffractive elements exhibiting a positional variation in at least one of amplitude, optical separation, and spatial phase over some portion ~~of the thickness~~ of the volume of the hologram, the volume hologram interacting with an input optical signal having a first spatial wavefront and a first temporal waveform to produce an output optical signal having a second spatial wavefront and a second temporal waveform, wherein the first and second spatial wavefronts differ in at least one of spatial wavefront shape and output direction, and the first temporal waveform differs from the second temporal waveform.

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13. (currently amended) The ~~volume hologram~~ apparatus of claim 12 wherein the input optical signal comprises an optical pulse.

14. (currently amended) The ~~volume hologram~~ apparatus of claim 12 wherein the first spatial wavefront originates from an input optical waveguide.

15. (original) The apparatus of claim 12 wherein the second spatial wavefront converges to an output optical waveguide.

16. (currently amended) The ~~volume hologram~~ apparatus of claim 12, wherein the volume hologram is an optical waveform cross-correlator.

17. (cancelled)

18. (currently amended) The ~~volume hologram~~ apparatus of claim 12, where each of the diffractive elements has a spherical contour and a center of curvature.

19. (currently amended) The ~~volume hologram~~ apparatus of claim 18, wherein ~~wherein~~ the centers of curvature of a plurality of the diffractive elements are coincident.

20. (currently amended) The ~~volume hologram~~ apparatus of claim 19, wherein the input optical signal originates from an input waveguide, and wherein the output

optical signal converges to an output waveguide, with the respective input and output waveguides located at respective conjugate image points of the plurality of the diffractive elements whose centers of curvature are coincident.

21. (currently amended) The ~~volume hologram~~ apparatus of claim 12 wherein the first spatial wavefront originates from an input optical waveguide and the second spatial wavefront converges to an output optical waveguide, and the input waveguide is separated from the output waveguide by a distance equal to or less than about 5000 microns.

22. (currently amended) The ~~volume hologram~~ apparatus of claim 12 wherein the first spatial wavefront originates from an input optical waveguide and the second spatial wavefront converges to an output optical waveguide, and the input waveguide is separated from the output waveguide by a distance between about 5000 microns and about 25 microns.

23. (currently amended) The ~~volume hologram~~ apparatus of claim 12 wherein the propagation direction of the input optical signal is not collinear to the propagation direction of the output optical signal.

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24. (currently amended) The ~~volume hologram~~ apparatus of claim 12 wherein all diffractive elements have an elliptical contour, with each diffractive element having a first focus and a second focus, and wherein a plurality of the respective first foci of the diffractive elements coincide, and a plurality of the respective second foci of the diffractive elements coincide.

25. (currently amended) The ~~volume hologram~~ apparatus of claim 24, wherein the input optical signal originates from an input waveguide and the output optical signal converges to an output waveguide, and where the respective input and output waveguides are located at the respective foci of the diffractive elements whose respective first foci coincide, and whose respective second foci coincide.

26-33. (withdrawn)

34. (currently amended) An apparatus comprising

an input port operative to launch an input optical signal having an input spatial wavefront and an input temporal waveform;

a volume hologram comprising a plurality of diffractive elements exhibiting a positional variation in at least one of amplitude, spatial separation, and spatial phase over some portion ~~of the thickness~~ of the volume of the hologram, the volume hologram interacting with the input optical signal to produce a plurality of output optical signals, each output optical signal having a respective output spatial wavefront that differs from the respective output spatial ~~wavefronts of all~~ wavefront of at least one of the other output optical signals, each output optical signal having a respective output temporal waveform, wherein at least two of the output optical signals have respective output temporal waveforms that differ from one another; and

a plurality of output ports configured to accept and transmit at least two of the plurality of output optical ~~pulses~~ signals.

35. (original) The apparatus of claim 34 wherein the input optical signal is an optical pulse.

36-44. (withdrawn)

45. (currently amended) A method comprising:

receiving an input optical signal comprising a first temporal waveform, into an input coupled to a volume hologram comprising a transfer function that comprises temporal information, the volume hologram coupled to an output;

diffracting the optical signal via ~~the~~ diffractive elements within the volume hologram, producing a diffracted optical signal comprising a second temporal waveform that differs from the first temporal waveform; and

directing the diffracted optical signal to the output.

46. (original) The method of claim 45, wherein the volume hologram further comprises spatial transformation information.

47. (original) The method of claim 46 wherein the diffracted optical signal is spatially transformed.

48. (original) The method of claim 45 wherein the input optical signal has a first direction of propagation and the diffracted optical signal has a second direction of

propagation, and where the first direction of propagation is not collinear to the second direction of propagation.

49. (original) The method of claim 45 wherein the input optical signal is an optical pulse.

50. (original) The method of claim 45 wherein the volume hologram further comprises spectral transformation information.

51. (original) The method of claim 50 wherein the diffracted optical signal is spectrally transformed.

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52. (original) The method of claim 50, wherein the volume hologram further comprises spatial transformation information.

53. (original) The method of claim 52 wherein the diffracted optical signal is spectrally and spatially transformed.

54. (original) The method of claim 45, wherein the volume hologram is an optical waveform cross-correlator.

55. (cancelled)

56-86. (cancelled)

87-105. (withdrawn)

106. (new) The apparatus of Claim 12, wherein each portion of the second temporal waveform includes contributions from a plurality of portions of the first spatial wavefront.

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107. (new) The apparatus of Claim 12, wherein each portion of the second spatial wavefront contributes to a plurality of portions of the second temporal waveform.

108. (new) The apparatus of Claim 12, the volume hologram residing within a planar optical waveguide, the input optical signal interacting with the volume hologram while propagating within the planar waveguide, propagation of the input optical signal within the planar waveguide being substantially guided in at least one dimension by the planar waveguide.

109. (new) The apparatus of Claim 108, the first spatial wavefront originating from an input optical waveguide, the input optical waveguide being a channel waveguide positioned so as to launch the input optical signal into an edge of the planar waveguide.

110. (new) The apparatus of Claim 108, the second spatial wavefront converging to an output optical waveguide, the output optical waveguide being a channel waveguide positioned so as to receive the output optical signal from an edge of the planar waveguide.

111. (new) The apparatus of Claim 34, wherein each portion of each of the output temporal waveforms includes contributions from a plurality of portions of the first spatial wavefront.

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112. (new) The apparatus of Claim 34, wherein each portion of each of the output spatial wavefronts contributes to a plurality of portions of the respective output temporal waveform.

113. (new) The apparatus of Claim 34, the volume hologram residing within a planar optical waveguide, the input optical signal interacting with the volume hologram while propagating within the planar waveguide, each of the input port and the plurality of output ports being positioned at an edge of the planar waveguide, propagation of the input optical signal within the planar waveguide being substantially guided in at least one dimension by the planar waveguide.

114. (new) The apparatus of Claim 113, the first spatial wavefront originating from an input optical waveguide, the input optical waveguide being a channel waveguide positioned so as to launch the input optical signal into the planar waveguide through the input port.

115. (new) The apparatus of Claim 113, the spatial wavefront of at least one of the output signals converging to a respective output optical waveguide, the output optical waveguide being a channel waveguide positioned so as to receive the output optical signal from an edge of the planar waveguide through the respective output port.

116. (new) The method of Claim 45, wherein each portion of the second temporal waveform includes contributions from a plurality of portions of a spatial wavefront of the input optical signal.

117. (new) The method of Claim 45, wherein each portion of a spatial wavefront of the diffracted optical signal contributes to a plurality of portions of the second temporal waveform.

118. (new) The method of Claim 45, the volume hologram residing within a planar optical waveguide, the input optical signal interacting with the volume hologram while propagating within the planar waveguide, the input and the output being positioned at an edge of the planar waveguide, propagation of the input optical signal within the planar waveguide being substantially guided in at least one dimension by the planar waveguide.

119. (new) The method of Claim 118, the input optical signal being received from an input optical waveguide, the input optical waveguide being a channel waveguide positioned so as to launch the input optical signal into the planar waveguide through the input.

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120. (new) The method of Claim 118, the diffracted optical signal being diffracted to an output optical waveguide, the output optical waveguide being a channel waveguide positioned so as to receive the diffracted optical signal from an edge of the planar waveguide through the output.

121. (new) An optical apparatus, comprising:

a volume hologram including a plurality of diffractive elements exhibiting a positional variation in at least one of amplitude, optical separation, and spatial phase over some portion of the volume of the hologram, the volume hologram residing within a planar optical waveguide, the volume hologram interacting with an input optical signal having a first spatial wavefront and a first temporal waveform to produce an output optical signal having a second spatial wavefront and a second temporal waveform, the input optical signal interacting with the volume hologram while propagating within the planar waveguide, propagation of the input optical signal within the planar

waveguide being substantially guided in at least one dimension by the planar waveguide, the first and second spatial wavefronts differing in at least one of spatial wavefront shape and output direction, the first temporal waveform differing from the second temporal waveform.

122. (new) The apparatus of Claim 121, wherein each portion of the second temporal waveform includes contributions from a plurality of portions of the first spatial wavefront.

123. (new) The apparatus of Claim 121, wherein each portion of the second spatial wavefront contributes to a plurality of portions of the second temporal waveform.

124. (new) The apparatus of claim 121 wherein the input optical signal comprises an optical pulse.

125. (new) The apparatus of claim 121, the first spatial wavefront originating from an input optical waveguide, the input optical waveguide being a channel waveguide positioned so as to launch the input optical signal into an edge of the planar waveguide.

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126. (new) The apparatus of claim 121, the second spatial wavefront converging to an output optical waveguide, the output optical waveguide being a channel waveguide positioned so as to receive the output optical signal from an edge of the planar waveguide.

127. (new) The apparatus of claim 121, wherein the volume hologram is an optical waveform cross-correlator.

128. (new) The apparatus of claim 121, where each of the diffractive elements has a substantially circular contour and a center of curvature.

129. (new) The apparatus of claim 128, wherein the centers of curvature of a plurality of the diffractive elements are substantially coincident.

130. (new) The apparatus of claim 129, wherein the input optical signal originates from an input waveguide, and wherein the output optical signal converges to an output waveguide, with the respective input and output waveguides located at

respective conjugate image points of the plurality of the diffractive elements whose centers of curvature are substantially coincident.

131. (new) The apparatus of claim 121 wherein the propagation direction of the input optical signal is not collinear to the propagation direction of the output optical signal.

132. (new) The apparatus of claim 121 wherein each of the diffractive elements has an elliptical contour, with each contour having a respective first focus and a respective second focus, and wherein a plurality of the respective first foci substantially coincide, and a plurality of the respective second foci substantially coincide.

133. (new) The apparatus of claim 132, wherein the input optical signal originates from an input waveguide and the output optical signal converges to an output waveguide, and wherein the respective input and output waveguides are located at the respective foci of the diffractive elements whose respective first foci coincide, and whose respective second foci substantially coincide.

134. (new) An optical apparatus, comprising:

at least one of a volume hologram and a feedback structure, including a plurality of diffractive elements exhibiting a positional variation in at least one of amplitude, optical separation, and spatial phase over some portion of the volume of the apparatus, the diffractive elements interacting with an input optical signal having a first spatial wavefront and at least one of a first temporal waveform and a first optical spectrum to produce an output optical signal having a second spatial wavefront and at least one of a second temporal waveform and a second optical spectrum, the first and second spatial wavefronts differing in at least one of spatial wavefront shape and output direction, the first and second optical signals differing in at least one of temporal waveform and optical spectrum.

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135. (new) The apparatus of Claim 134, wherein each portion at least one of the second temporal waveform and second optical spectrum includes contributions from a plurality of portions of the first spatial wavefront.

136. (new) The apparatus of Claim 134, wherein each portion of the second spatial wavefront contributes to a plurality of portions of at least one of the second temporal waveform and the second optical spectrum.

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